

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L2	183	instrument\$5 near5 ((type near3 check\$3) or (class near3 (check\$3 or validation or verification or valid)) or (incompatible near5 type))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/03/14 07:51
L3	169	instrument\$5 near5 (type near3 check\$3)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/03/14 07:53
L4	14	I2 not I3	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/03/14 07:53
S1	9	type adj (test\$3 or check\$3) same static\$3 and (optimal\$2 or optimiz\$5 or optimis\$5) and inlin\$3	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/10/25 13:24
S2	20	("7080354" "6948156" "6978448" "5999732" "5579518" "5345384" "6892212" "5995754" "7120572" "6658657" "6658657" "6079032" "6072951" "6317872" "5701489" "6971091" "6170083" "5361351" "6760907").pn. and (determin\$3 or calculat\$4) and ("number of" or threshold or benchmark or "less than" or more or less\$2 or exceed\$3 or minimiz\$5 or count)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/10/25 13:31
S3	16	("7080354" "6948156" "6978448" "5999732" "5579518" "5345384" "6892212" "5995754" "7120572" "6658657" "6658657" "6079032" "6072951" "6317872" "5701489" "6971091" "6170083" "5361351" "6760907").pn. and (determin\$3 or calculat\$4 or profil\$3) same ("number of" or threshold or benchmark or "less than" or more or less\$2 or exceed\$3 or minimiz\$5 or count)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/10/25 13:32

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S4	16	("7080354" "6948156" "6978448" "5999732" "5579518" "5345384" "6892212" "5995754" "7120572" "6658657" "6658657" "6079032" "6072951" "6317872" "5701489" "6971091" "6170083" "5361351" "6760907").pn. and (determin\$3 or calculat\$4 or profil\$3) same ("number of" or threshold or benchmark or "less than" or more or less\$2 or exceed\$3 or minimiz\$5 or count or metric or statistic\$4)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/10/25 13:40
S5	3847	(determin\$3 or calculat\$4 or profil\$3 or sampl\$3 or instrument\$5) same (inlin\$3 or "in-line" or "in-lining") same ("number of" or threshold or benchmark or "less than" or more or less\$2 or exceed\$3 or minimiz\$5 or count or metric or statistic\$4)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/10/25 13:42
S6	68	(717/14?.ccls. or 717/15?.ccls.) and (determin\$3 or calculat\$4 or profil\$3 or sampl\$3 or instrument\$5) same (inlin\$3 or "in-line" or "in-lining") same ("number of" or threshold or benchmark or "less than" or more or less\$2 or exceed\$3 or minimiz\$5 or count or metric or statistic\$4)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/10/25 13:43
S7	64	S6 not S4	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2007/03/13 16:56
S8	122	class near2 ((type adj check\$3) or validation or verification or valid) and (inlin\$3 or "in-line" or "code expansion")	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2007/03/13 16:58
S9	20	class near2 ((type adj check\$3) or validation or verification or valid) and (inlin\$3 or "in-line" or "code expansion") and (type near3 (frequency or frequencies or count or "number of")) and (cost or optimal\$2 or optimiz\$5 or optimis\$5 or threshold or maximum)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2007/03/13 17:17

EAST Search History

S10	1	class near2 ((type adj check\$3) or validation or verification or valid) and (inlin\$3 or "in-line" or "code expansion") and (type near3 (frequency or frequencies or count or "number of")) and (cost or optimal\$2 or optimiz\$5 or optimis\$5 or threshold or maximum) and (call\$3 or invoc\$3 or invocation or branch\$3 or jump\$3) same class near2 ((type adj check\$3) or validation or verification or valid)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2007/03/13 17:01
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S13	16	(link\$3 or linktime or runtime or profil\$3 or instrument\$5) same class near5 ((type adj check\$3) or validation or verification or valid) and (add\$3 or generat\$3 or creat\$3 or patch\$3) same (((replac\$3 near3 call\$3) near3 "with function") or inlin\$3 or "in-line" or "code expansion" or (class near3 (check\$3 or validation or verification or valid))) and ((class or type) near3 (frequency or frequencies or count or "number of")) and (cost or optimal\$2 or optimiz\$5 or optimis\$5 or threshold or maximum or best)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2007/03/13 17:27

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S14	0	717/130.ccls. and (link\$3 or linktime or runtime or profil\$3 or instrument\$5) same class near5 ((type adj check\$3) or validation or verification or valid) and (add\$3 or generat\$3 or creat\$3 or patch\$3) same (((replac\$3 near3 call\$3) near3 "with function") or inlin\$3 or "in-line" or "code expansion" or (class near3 (check\$3 or validation or verification or valid)))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2007/03/13 17:28
S15	1	717/131.ccls. and (link\$3 or linktime or runtime or profil\$3 or instrument\$5) same class near5 ((type adj check\$3) or validation or verification or valid) and (add\$3 or generat\$3 or creat\$3 or patch\$3) same (((replac\$3 near3 call\$3) near3 "with function") or inlin\$3 or "in-line" or "code expansion" or (class near3 (check\$3 or validation or verification or valid)))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2007/03/13 17:29
S16	2	717/141.ccls. and (link\$3 or linktime or runtime or profil\$3 or instrument\$5) same class near5 ((type adj check\$3) or validation or verification or valid) and (add\$3 or generat\$3 or creat\$3 or patch\$3) same (((replac\$3 near3 call\$3) near3 "with function") or inlin\$3 or "in-line" or "code expansion" or (class near3 (check\$3 or validation or verification or valid)))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2007/03/13 17:33
S17	23111	(add\$3 or generat\$3 or creat\$3 or patch\$3 or instrument\$5) same (((replac\$3 near3 call\$3) near3 "with function") or inlin\$3 or "in-line" or "code expansion" or (class near3 (check\$3 or validation or verification or valid)) or (incompatible near5 type))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2007/03/13 17:36
S18	374	(add\$3 or generat\$3 or creat\$3 or patch\$3 or instrument\$5) same (inlin\$3 or "in-line" or "code expansion") and ((class near3 (check\$3 or validation or verification or valid)) or (incompatible near5 type) or (type near2 check\$3))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2007/03/13 17:38

EAST Search History

S19	134	(add\$3 or generat\$3 or creat\$3 or patch\$3 or instrument\$5) near5 (inlin\$3 or "in-line" or "code expansion") and ((class near3 (check\$3 or validation or verification or valid)) or (incompatible near5 type) or (type near2 check\$3))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2007/03/13 18:11
S20	31	(add\$3 or generat\$3 or creat\$3 or patch\$3 or instrument\$5) near5 (link\$3 near2 (code or instruction)) and (inlin\$3 or "in-line" or "code expansion") and ((class near3 (check\$3 or validation or verification or valid)) or (incompatible near5 type) or (type near2 check\$3))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/03/13 18:19
S21	169	instrument\$5 near5 (type near3 check\$3)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2007/03/14 07:52



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[BOOK] ATOM: a system for building customized program analysis tools - [group of 2 »](#)

A Srivastava, A Eustace - 1994 - ACM Press New York, NY, USA
 ... ATOM, using OM **link**-time technology, organizes the fi ... tools such
 as Tango Lite, which
instrument assem- bly ... **Instrumenting** library routines is inconvenient
 as ...

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[A pooled analysis of magnetic fields, wire codes, and childhood leukemia - group of 5 »](#)

S Greenland, AR Sheppard, WT Kaune, C Poole, MA ... - Epidemiology, 2000 - epidem.com

... at a time and make instrumental (not **instrument**) variable corrections.

... A pooled analysis

of magnetic fields, wire **codes**, and childhood ... [Context **Link**]. 6.

Ahlbom ...

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[Link-time and run-time error detection, and program instrumentation - group of 2 »](#)

DR Chase, SC Kendall, MP Mitchell - US Patent 6,149,318, 2000 - Google Patents

... The **link**-time error checking diag -noses violations of the ... To add **instrumentation**

to aC or C++ program, pre ... syntax tree before a back-end generates **code** for the ...

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[Intercepting and **Instrumenting** COM Applications - group of 11 »](#)
 GC Hunt, ML Scott - unix.org

... At **link** time, the linker embeds in the ... the cost of redirection, but not any additional

instrumentation. ... than DLL redirection or application **code** modification. ...

Cited by 18 - Related Articles - Web Search

Mobile **code** security by Java bytecode instrumentation - group of 16 »
A Chander, JC Mitchell, I Shin - 2001 DARPA Information Survivability Conference & Exposition ..., 2001 - doi.ieeeecs.org

... The bytecode **instrumentation** technique itself is presented in Section ... proxies are

aug-mented to **instrument** the component ... a web page, like a graphic or a **link**. ...

Cited by 25 - Related Articles - Web Search

Minimum Data Set for Home Care: A Valid Instrument to Assess Frail Older People Living in the ...

M Instrument, S Analyses - Medical Care, 2000 - lww-medicalcare.com
... 300 items include many triggers that **link** the MDS ... a very simple and efficient assessment

instrument for elderly ... patients had a severe impairment (**code** 4 = total ...

Cited by 48 - Related Articles - Web Search - BL Direct

BIT: A Tool for **Instrumenting** Java Bytecodes - group of 8 »

HB Lee, BG Zorn - USENIX Symposium on Internet Technologies and Systems, 1997 - usenix.org

... Java world by allowing a user to **instrument** a JVM ... BIT: Bytecode **Instrumenting**= Tool ...

"A Practical System for Intermodule **Code** Optimization at **Link**-Time." Journal ...

Cited by 79 - Related Articles - Web Search

Teaching the **Code** Book: Preparation for Data Entry - group of 3 »

ZR Wolf - Nurse Educator, 2003 - nurseeducatoronline.com

... from **code** book exercises to appreciate the **link** between instruments and data analysis.

Each semester that I teach the graduate course, I change the **instrument** ...

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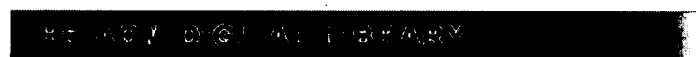
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Relevance scale

1 [Inline function expansion for compiling C programs](#)

☒ P. P. Chang, W.-W. Hwu

June 1989 **ACM SIGPLAN Notices , Proceedings of the ACM SIGPLAN 1989 Conference on Programming language design and implementation PLDI '89**, Volume 30, Issue 7

Publisher: ACM Press

 Full text available: ☒ pdf(1.14 MB)

 Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)

Inline function expansion replaces a function call with the function body. With automatic inline function expansion, programs can be constructed with many small functions to reduce complexity and then rely on the compilation to eliminate most of the function calls.

Therefore, inline expansion serves as a tool for satisfying two conflicting goals: minimizing the complexity of the program development and minimizing the function call overhead of program execution. A simple inline expansion procedure ...

2 [Run-time evaluation of opportunities for object inlining in Java](#)

☒ Ondrej Lhoták, Laurie Hendren

November 2002 **Proceedings of the 2002 joint ACM-ISCOPE conference on Java Grande JGI '02**

Publisher: ACM Press

Full text available:  [pdf\(188.19 KB\)](#) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)

Object-oriented languages, such as Java, encourage the use of many small objects linked together by field references, instead of a few monolithic structures. While this practice is beneficial from a program design perspective, it can slow down program execution by incurring many pointer indirections. One solution to this problem is object inlining: where the compiler can safely do so, it fuses small objects together, thus removing the reads/writes to the removed field, saving the memory needed to ...


Keywords: Java, compilers, object inlining, optimization

3 [Flow-directed inlining](#)

 Suresh Jagannathan, Andrew Wright

May 1996 **ACM SIGPLAN Notices , Proceedings of the ACM SIGPLAN 1996 conference on Programming language design and implementation PLDI '96**, Volume 31, Issue 5

Publisher: ACM Press

Full text available:  [pdf\(1.33 MB\)](#) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)


A *flow-directed inlining* strategy uses information derived from control-flow analysis to specialize and inline procedures for functional and object-oriented languages. Since it uses control-flow analysis to identify candidate call sites, flow-directed inlining can inline procedures whose relationships to their call sites are not apparent. For instance, procedures defined in other modules, passed as arguments, returned as values, or extracted from control structures can all be inlined. Flow-d ...

4 [Function inlining under code size constraints for embedded processors](#)

Rainer Leupers, Peter Marwedel

November 1999 **Proceedings of the 1999 IEEE/ACM international conference on Computer-aided design ICCAD '99**

Publisher: IEEE Press

Full text available:  [pdf\(184.10 KB\)](#) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)

Function inlining is a compiler optimization that generally increases performance at the expense of larger code size. However, current inlining techniques do not meet the specifications of ...


demands in the design of embedded systems, since they are based on simple heuristics; they generate code of unpredictable size. This paper presents a novel approach to function inlining in C compilers for embedded processors, which aims at a maximum program speed under a global limit on code size. The co ...

5 Dynamic Adaptive compilation: Adaptive online context-sensitive inlining

Kim Hazelwood, David Grove


March 2003 **Proceedings of the international symposium on Code generation and optimization: feedback-directed and runtime optimization CGO '03**

Publisher: IEEE Computer Society

Full text available:  [pdf\(1.06 MB\)](#) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)


As current trends in software development move toward more complex object-oriented programming, inlining has become a vital optimization that provides substantial performance improvements to C++ and Java programs. Yet, the aggressiveness of the inlining algorithm must be carefully monitored to effectively balance performance and size. The state-of-the-art is to use profile information (associated with call edges) to guide inlining decisions. In the presence of virtual method calls, profile ...

6 An evaluation of automatic object inline allocation techniques

 Julian Dolby, Andrew A. Chien


October 1998 **ACM SIGPLAN Notices , Proceedings of the 13th ACM SIGPLAN conference on Object-oriented programming, systems, languages, and applications OOPSLA '98, Volume 33 Issue 10**

Publisher: ACM Press

Full text available:  [pdf\(2.26 MB\)](#) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)


Object-oriented languages such as Java and Smalltalk provide a uniform object reference model, allowing objects to be conveniently shared. If implemented directly, these unified reference models can suffer in efficiency due to additional memory dereferences and memory management operations. Automatic *inline allocation* of child objects within parent objects can reduce overheads of heap-allocated pointer-referenced objects. We present compiler analyses to identify inlinable fields by type ...

7 The effectiveness of flow analysis for inlining

 J. Michael Ashley


August 1997 **ACM SIGPLAN Notices , Proceedings of the second ACM SIGPLAN international conference on Functional programming ICFP '97**, Volume 8
Issue 8

Publisher: ACM Press

Full text available:  [pdf\(1.13 MB\)](#) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)


An interprocedural flow analysis can justify inlining in higher-order languages. In principle, more inlining can be performed as analysis accuracy improves. This paper compares four flow analyses to determine how effectively they justify inlining in practice. The paper has two contributions. First, the relative merits of the flow analyses are measured with all variables held constant. The four analyses include two monovariant and two polyvariant analyses that cover a wide range of the ac ...

8 Automatic inline allocation of objects

 Julian Dolby

May 1997 **ACM SIGPLAN Notices , Proceedings of the ACM SIGPLAN 1997 conference on Programming language design and implementation PLDI '97**, Volume 5
Issue 5

Publisher: ACM Press

Full text available:  [pdf\(1.37 MB\)](#) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)

Object-oriented languages like Java and Smalltalk provide a uniform object model that simplifies programming by providing a consistent, abstract model of object behavior. However, direct implementations introduce overhead, removal of which requires aggressive implementation techniques (e.g. type inference, function specialization); in this paper, we introduce *object inlining*, an optimization that automatically inline allocates objects within containers (as is done by hand in C++) within a unified ...

9 Aggressive inlining

 Andrew Ayers, Richard Schooler, Robert Gottlieb

May 1997 **ACM SIGPLAN Notices , Proceedings of the ACM SIGPLAN 1997 conference on Programming language design and implementation PLDI '97**, Volume 5
Issue 5

Publisher: ACM Press

Full text available:  [pdf\(1.40 MB\)](#) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)


Existing research understates the benefits that can be obtained from inlining and cloning especially when guided by profile information. Our implementation of inlining and cloning yields excellent results on average and very rarely lowers performance. We believe our results can be explained by a number of factors: inlining at the intermediate-code level removes most technical restrictions on what can be inlined; the ability to inline across modules and incorporate profile information enables ...

10 Field analysis: getting useful and low-cost interprocedural information

◆ Sanjay Ghemawat, Keith H. Randall, Daniel J. Scales

May 2000 **ACM SIGPLAN Notices**, **Proceedings of the ACM SIGPLAN 2000 conference on Programming language design and implementation PLDI '00**, Volume 35 Issue 5

Publisher: ACM Press

Full text available:  [pdf\(686.96 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)


We present a new limited form of interprocedural analysis called field analysis that can be used by a compiler to reduce the costs of modern language features such as object-oriented programming, automatic memory management, and run-time checks required for type safety. Unlike many previous interprocedural analyses, our analysis is cheap, and does not require access to the entire program. Field analysis exploits the declared access restrictions placed on fields in a module ...

11 Polymorphic splitting: an effective polyvariant flow analysis

◆ Andrew K. Wright, Suresh Jagannathan

January 1998 **ACM Transactions on Programming Languages and Systems (TOPLAS)**, Volume 20 Issue 1

Publisher: ACM Press


Full text available:  [pdf\(517.76 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#), [review](#)

This article describes a general-purpose program analysis that computes global control and data-flow information for higher-order, call-by-value languages. The analysis employs a novel form of polyvariance called polymorphic splitting that uses let-expressions as syntactic clues to gain precision. The information derived from the analysis is used both to eliminate run-time checks and to inline procedure calls. The analysis and optimizations have been applied to a suite of Scheme programs ...

Keywords: flow analysis, inlining, polyvariance, run-time checks

12 Partitioning sequential programs for CAD using a three-step approach

◆ Frank Vahid


July 2002 **ACM Transactions on Design Automation of Electronic Systems (TODAES)**
Volume 7 Issue 3**Publisher:** ACM PressFull text available:  pdf(147.12 KB) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)

Many computer-aided design problems involve solutions that require the partitioning large sequential program written in a language such as C or VHDL. Such partitioning improve design metrics such as performance, power, energy, size, input/output lines, ; even CAD tool run-time and memory requirements, by partitioning among hardware modules, hardware and software processors, or even among time-slices in reconfigura computing devices. Previous partitioning approaches typically presel ...

Keywords: Partitioning, behavioral partitioning, functional partitioning, hardware/sof partitioning, system level partitioning

13 Towards better inlining decisions using inlining trials

◆ Jeffrey Dean, Craig Chambers

July 1994 **ACM SIGPLAN Lisp Pointers , Proceedings of the 1994 ACM conference LISP and functional programming LFP '94**, Volume VII Issue 3**Publisher:** ACM PressFull text available:  pdf(1.24 MB) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)

Inlining trials are a general mechanism for making better automatic decisions about w a routine is profitable to inline. Unlike standard source-level inlining heuristics, an inl trial captures the effects of optimizations applied to the body of the inlined routine wh calculating the costs and benefits of inlining. The results of inlining trials are stored ir persistent database to be reused when making future inlining decisions at similar call : Type group analysis can d ...


14 Computing the MDMT decomposition

◆ Linda Kaufman

December 1995 **ACM Transactions on Mathematical Software (TOMS)**, Volume 21

4


Publisher: ACM Press

Full text available:  pdf(829.62 KB) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#), [review](#)

The MDMT factorization of an $n \times n$ symmetric indefinite matrix A can be used to solve a linear system with A as the coefficient matrix. This factorization can be computed efficiently using an algorithm given in 1977 by Bunch and Kaufman. The LAPACK project has been implementing block versions of well-known algorithms for solving dense linear system eigenvalue problems. The block version of the ...


Keywords: LAPACK, block factorization, linear systems (direct methods), symmetric indefinite

15 A graphical interval logic for specifying concurrent systems

 L. K. Dillon, G. Kutty, L. E. Moser, P. M. Melliar-Smith, Y. S. Ramakrishna

April 1994 **ACM Transactions on Software Engineering and Methodology (TOSEM)**
Volume 3 Issue 2


Publisher: ACM Press

Full text available:  pdf(1.96 MB) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#), [review](#)


This article describes a graphical interval logic that is the foundation of a tool set supporting formal specification and verification of concurrent software systems. Experience has shown that most software engineers find standard temporal logics difficult to understand and use. The objective of this article is to enable software engineers to specify and reason about temporal properties of concurrent systems more easily by providing them with a logic that has an intuitive graphical representation ...

Keywords: automated proof-checking, concurrent systems, formal specifications, graphical interval logic, temporal logic, timing diagrams, visual languages

16 Online feedback-directed optimization of Java


 Matthew Arnold, Michael Hind, Barbara G. Ryder

November 2002 **ACM SIGPLAN Notices , Proceedings of the 17th ACM SIGPLAN conference on Object-oriented programming, systems, languages, a**


applications OOPSLA '02, Volume 37 Issue 11**Publisher:** ACM PressFull text available:  pdf(463.00 KB) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)

This paper describes the implementation of an online feedback-directed optimization system. The system is fully automatic; it requires no prior (offline) profiling run. It uses previously developed low-overhead instrumentation sampling framework to collect control flow graph edge profiles. This profile information is used to drive several traditional optimizations, as well as a novel algorithm for performing feedback-directed control flow graph node splitting. We empirically evaluate this system ...

Keywords: adaptive optimization, dynamic optimization, online algorithms, virtual machines

17 [A framework for interprocedural optimization in the presence of dynamic class loading](#) Vugranam C. Sreedhar, Michael Burke, Jong-Deok ChoiMay 2000 **ACM SIGPLAN Notices , Proceedings of the ACM SIGPLAN 2000 conference on Programming language design and implementation PLDI '00, Volume 33 Issue 5****Publisher:** ACM PressFull text available:  pdf(576.50 KB) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)

Dynamic class loading during program execution in the Java Programming Language is a major impediment for generating code that is as efficient as code generated using static whole-program analysis and optimization. Whole-program analysis and optimization is possible in languages, such as C++, that do not allow new classes and/or methods to be loaded during program execution. One solution for performing whole-program analysis and avoiding incorrect execution after a new class is loaded is to inline ...

18 [Compiler transformations for high-performance computing](#) David F. Bacon, Susan L. Graham, Oliver J. SharpDecember 1994 **ACM Computing Surveys (CSUR), Volume 26 Issue 4****Publisher:** ACM PressFull text available:  pdf(6.32 MB) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#), [review](#)

In the last three decades a large number of compiler transformations for optimizing programs have been implemented. Most optimizations for uniprocessors reduce the number of instructions executed by the program using transformations based on the analysis of scalar quantities and data-flow techniques. In contrast, optimizations for high-performance superscalar, vector, and parallel processors maximize parallelism and memory locality transformations that rely on tracking the properties of ...

Keywords: compilation, dependence analysis, locality, multiprocessors, optimization, parallelism, superscalar processors, vectorization

19 An automatic object inlining optimization and its evaluation

◆ Julian Dolby, Andrew Chien

May 2000 **ACM SIGPLAN Notices , Proceedings of the ACM SIGPLAN 2000 conference on Programming language design and implementation PLDI '00**, Volume 35, Issue 5

Publisher: ACM Press

Full text available:  [pdf\(877.17 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)


Automatic object inlining [19, 20] transforms heap data structures by fusing parent and child objects together. It can improve runtime by reducing object allocation and pointer dereference costs. We report continuing work studying object inlining optimizations. In particular, we present a new semantic derivation of the correctness conditions for object inlining, and program analysis which extends our previous work. And we present an object inlining transformation, focusing ...

20 Unexpected side effects of inline substitution: a case study

◆ Keith D. Cooper, Mary W. Hall, Linda Torczon

March 1992 **ACM Letters on Programming Languages and Systems (LOPLAS)**, Volume 3, Issue 1

Publisher: ACM Press

Full text available:  [pdf\(740.92 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#), [review](#)

The structure of a program can encode implicit information that changes both the shape and the speed of the generated code. Interprocedural transformations like inlining often discard information; using interprocedural data-flow information as a basis for optimization can have the same effect. In the course of a study on inline substitution with commercial

FORTRAN compilers, we encountered unexpected performance problems in one of the programs. This paper describes the specific ...





Keywords: inline substitution, interprocedural analysis, interprocedural optimization

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1 [Field analysis: getting useful and low-cost interprocedural information](#)
☒ Sanjay Ghemawat, Keith H. Randall, Daniel J. Scales

May 2000 **ACM SIGPLAN Notices , Proceedings of the ACM SIGPLAN 2000 conference on Programming language design and implementation PLDI '00, Volume 31, Issue 5**

Publisher: ACM Press

Full text available: [pdf\(686.96 KB\)](#) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)

We present a new limited form of interprocedural analysis called field analysis that can be used by a compiler to reduce the costs of modern language features such as object-oriented programming, automatic memory management, and run-time checks required for type safety. Unlike many previous interprocedural analyses, our analysis is cheap, and does not require access to the entire program. Field analysis exploits the declared access restrictions placed on fields in a module ...

2 [A framework for interprocedural optimization in the presence of dynamic class loading](#)
☒ Vugranam C. Sreedhar, Michael Burke, Jong-Deok Choi

May 2000 **ACM SIGPLAN Notices , Proceedings of the ACM SIGPLAN 2000 conference on Programming language design and implementation PLDI '00, Volume 31, Issue 5**

Publisher: ACM Press


Full text available: [pdf\(576.50 KB\)](#) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)

KB)citings, index terms

Dynamic class loading during program execution in the Java Programming Language impediment for generating code that is as efficient as code generated using static whole-program analysis and optimization. Whole-program analysis and optimization is possible in some languages, such as C++, that do not allow new classes and/or methods to be loaded during program execution. One solution for performing whole-program analysis and avoiding incorrect execution after a new class is loaded is to in ...

3 Techniques for obtaining high performance in Java programs

◆ Iffat H. Kazi, Howard H. Chen, Berdenia Stanley, David J. Lilja
September 2000 **ACM Computing Surveys (CSUR)**, Volume 32 Issue 3
Publisher: ACM Press


Full text available:  [pdf\(816.13 KB\)](#) Additional Information: [full citation](#), [abstract](#), [reference](#), [citings](#), [index terms](#)

This survey describes research directions in techniques to improve the performance of programs written in the Java programming language. The standard technique for Java execution is interpretation, which provides for extensive portability of programs. A Java interpreter dynamically executes Java bytecodes, which comprise the instruction set of the Java Virtual Machine (JVM). Execution time performance of Java programs can be improved through compilation, possibly at the expense of portability ...

Keywords: Java, Java virtual machine, bytecode-to-source translators, direct compilation, dynamic compilation, interpreters, just-in-time compilers

4 Lessons learned from the OS/400 OO project

◆ William Berg, Marshall Cline, Mike Girou
October 1995 **Communications of the ACM**, Volume 38 Issue 10
Publisher: ACM Press

Full text available:  [pdf\(339.92 KB\)](#) Additional Information: [full citation](#), [abstract](#), [reference](#), [citings](#), [index terms](#)

This article describes some of the lessons learned when a team of 150 developers with minimal prior exposure to object-oriented (OO) technology undertook a large development project. Team members became proficient in OO design, using C++ as an OO language rather than just using C++ as a better C, and developed IBM's RISC version of the AS/400 and System/36 operating systems from 1992 to 1994 in Rochester, Minnesota. The project

contains 14,000 thousand classes, 90,000 thousand methods, an ...

5 Reducing virtual call overheads in a Java VM just-in-time compiler

◆ Junpyo Lee, Byung-Sun Yang, Suhyun Kim, Kemal Ebcioglu, Erik Altman, Seungil Lee, C. Chung, Heungbok Lee, Je Hyung Lee, Soo-Mook Moon

March 2000 **ACM SIGARCH Computer Architecture News**, Volume 28 Issue 1

Publisher: ACM Press

Full text available:  pdf(994.66 KB) Additional Information: [full citation](#), [abstract](#), [index terms](#)

Java, an object-oriented language, uses *virtual methods* to support the extension and reuse of classes. Unfortunately, virtual method calls affect performance and thus require an efficient implementation, especially when just-in-time (JIT) compilation is done. *Inline caches* and *type feedback* are solutions used by compilers for dynamically-typed object-oriented languages such as SELF [1, 2, 3], where virtual call overheads are much more critical to performance than in Java. Wi ...


Keywords: Java JIT compilation, adaptive compilation, inline cache, type feedback, virtual method call

6 Interactive type analysis and extended message splitting; optimizing dynamically-typed object-oriented programs

◆ Craig Chambers, David Ungar

June 1990 **ACM SIGPLAN Notices , Proceedings of the ACM SIGPLAN 1990 conference on Programming language design and implementation PLDI '90**, Volume 23 Issue 6

Publisher: ACM Press

Full text available:  pdf(1.58 MB) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)


Object-oriented languages have suffered from poor performance caused by frequent and slow dynamically-bound procedure calls. The best way to speed up a procedure call is to compile it out, but dynamic binding of object-oriented procedure calls without static runtime type information precludes inlining. Iterative type analysis and extended message splitting are new compilation techniques that extract much of the necessary type information at compile time to make it possible ...

7 Fast subtype checking in the HotSpot JVM

◆ Cliff Click, John Rose

November 2002 **Proceedings of the 2002 joint ACM-ISCOPE conference on Java G
JGI '02**

Publisher: ACM Press

Full text available:  [pdf\(61.60 KB\)](#) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)

We present the fast subtype checking implemented in Sun's HotSpot JVM. Subtype checks occur when a program wishes to know if class S implements class T, where S and T are both known at compile-time. Large Java programs will make millions or even billions of such checks, hence a fast check is essential. In actual benchmark runs our technique performs complete subtype checks in 3 instructions (and only 1 memory reference) essentially all the time. In rare instances it reverts to a slower array ...


Keywords: Java, checkcast, instanceof, subtype, typecase

8 Making pure object-oriented languages practical

◆ Craig Chambers, David Ungar

November 1991 **ACM SIGPLAN Notices , Conference proceedings on Object-oriented programming systems, languages, and applications OOPSLA '91, Volume 26 Issue 11**

Publisher: ACM Press


Full text available:  [pdf\(1.86 MB\)](#) Additional Information: [full citation](#), [references](#), [citing index terms](#)

9 Practicing JUDO: Java under dynamic optimizations

◆ Michał Cierniak, Guei-Yuan Lueh, James M. Stichnoth

May 2000 **ACM SIGPLAN Notices , Proceedings of the ACM SIGPLAN 2000 conference on Programming language design and implementation PLDI '00, Volume 31 Issue 5**

Publisher: ACM Press

Full text available:  [pdf\(190.06 KB\)](#) Additional Information: [full citation](#), [abstract](#), [reference citations](#), [index terms](#)

A high-performance implementation of a Java Virtual Machine (JVM) consists of efficient


implementation of Just-In-Time (JIT) compilation, exception handling, synchronization mechanism, and garbage collection (GC). These components are tightly coupled to achieve high performance. In this paper, we present some static and dynamic techniques implemented in the JIT compilation and exception handling of the Microprocessor Research Lab Virtual Machine (MRL VM), ...

10 Polymorphic splitting: an effective polyvariant flow analysis

◆ Andrew K. Wright, Suresh Jagannathan

January 1998 **ACM Transactions on Programming Languages and Systems (TOPLAS)**
Volume 20 Issue 1

Publisher: ACM Press

Full text available:  [pdf\(517.76 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#), [review](#)

This article describes a general-purpose program analysis that computes global control and data-flow information for higher-order, call-by-value languages. The analysis employs a novel form of polyvariance called polymorphic splitting that uses let-expressions as syntactic clues to gain precision. The information derived from the analysis is used both to eliminate run-time checks and to inline procedure calls. The analysis and optimizations have been applied to a suite of Scheme programs ...


Keywords: flow analysis, inlining, polyvariance, run-time checks

11 Inline routines in VAXELN Pascal

◆ M. Donald MacLaren

June 1984 **ACM SIGPLAN Notices , Proceedings of the 1984 SIGPLAN symposium on Compiler construction SIGPLAN '84**, Volume 19 Issue 6

Publisher: ACM Press

Full text available:  [pdf\(754.19 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#)

This paper describes the implementation of inline procedures and functions in the VAXELN Pascal compiler. Inline expansion translates the reverse Polish text produced by the parser into an intermediate language like that used in the VAX-11 PL/I and C compilers. The paper gives detailed descriptions of the front end's organization as it relates to inline routines and the symbol substitutions made during inline expansion. The paper also discusses global optimization and the compiler's treatment ...

12 Effectiveness of cross-platform optimizations for a java just-in-time compiler

◆ Kazuaki Ishizaki, Mikio Takeuchi, Kiyokuni Kawachiya, Toshio Suganuma, Osamu Go
Tatsushi Inagaki, Akira Koseki, Kazunori Ogata, Motohiro Kawahito, Toshiaki Yasue,
Takeshi Ogasawara, Tamiya Onodera, Hideaki Komatsu, Toshio Nakatani

October 2003 **ACM SIGPLAN Notices , Proceedings of the 18th annual ACM SIGPLAN
conference on Object-oriented programming, systems, languages, and
applications OOPSLA '03**, Volume 38 Issue 11

Publisher: ACM Press

Full text available:  [pdf\(405.65 KB\)](#) Additional Information: [full citation](#), [abstract](#), [reference
citations](#), [index terms](#)

This paper describes the system overview of our Java Just-In-Time (JIT) compiler, which is the basis for the latest production version of IBM Java JIT compiler that supports a diversity of processor architectures including both 32-bit and 64-bit modes, CISC, RISC, and VLIW architectures. In particular, we focus on the design and evaluation of the cross-platform optimizations that are common across different architectures. We studied the effectiveness of each optimization by selectively disabling ...


Keywords: Java, just-in-time compiler, optimization

13 Adapting virtual machine techniques for seamless aspect support

◆ Christoph Bockisch, Matthew Arnold, Tom Dinkelaker, Mira Mezini

October 2006 **ACM SIGPLAN Notices , Proceedings of the 21st annual ACM SIGPLAN
conference on Object-oriented programming systems, languages, and
applications OOPSLA '06**, Volume 41 Issue 10

Publisher: ACM Press


Full text available:  [pdf\(266.90 KB\)](#) Additional Information: [full citation](#), [abstract](#), [reference
index terms](#)

Current approaches to compiling aspect-oriented programs are inefficient. This inefficiency has negative effects on the productivity of the development process and is especially prohibitive for dynamic aspect deployment. In this work, we present how well-known virtual machine techniques can be used with only slight modifications to support fast aspect deployment while retaining runtime performance. Our implementation accelerates dynamic aspect deployment by several orders of magnitude relative to ...


Keywords: aspect weaving, aspect-oriented programming, dynamic deployment, environment-based weaving, virtual machine support

14 TIL: a type-directed optimizing compiler for ML

◆ D. Tarditi, G. Morrisett, P. Cheng, C. Stone, R. Harper, P. Lee

May 1996 **ACM SIGPLAN Notices , Proceedings of the ACM SIGPLAN 1996 conference on Programming language design and implementation PLDI '96, Volume 31 Issue 5****Publisher:** ACM PressFull text available:  [pdf\(1.23 MB\)](#) Additional Information: [full citation](#), [references](#), [citing index terms](#)**15** Session 2: Extended static checking for haskell

◆ Dana N. Xu

September 2006 **Proceedings of the 2006 ACM SIGPLAN workshop on Haskell Haskell '06****Publisher:** ACM PressFull text available:  [pdf\(233.55 KB\)](#) Additional Information: [full citation](#), [abstract](#), [reference index terms](#)

Program errors are hard to detect and are costly both to programmers who spend significant efforts in debugging, and to systems that are guarded by runtime checks. Extended static checking can reduce these costs by helping to detect bugs at compile-time, where possible. Extended static checking has been applied to objectoriented languages, like Java and C++, but it has not been applied to a lazy functional language, like Haskell. In this paper, we describe an extended static checking tool for Haskell.

Keywords: counterexample guided unrolling, pre/postcondition, symbolic simplification**16** Exploiting prolific types for memory management and optimizations

◆ Yefim Shuf, Manish Gupta, Rajesh Bordawekar, Jaswinder Pal Singh

January 2002 **ACM SIGPLAN Notices , Proceedings of the 29th ACM SIGPLAN-SIGACT symposium on Principles of programming languages POPL 2002, Volume 37 Issue 1****Publisher:** ACM PressFull text available:  [pdf\(203.59 KB\)](#) Additional Information: [full citation](#), [abstract](#), [reference index terms](#)

KB)citings

In this paper, we introduce the notion of *prolific* and *non-prolific* types, based on the number of instantiated objects of those types. We demonstrate that distinguishing between the types enables a new class of techniques for memory management and data locality, and facilitates the deployment of known techniques. Specifically, we first present a new *type-based* approach to garbage collection that has similar attributes but lower cost than generational collection. Then we de ...

17 The Python compiler for CMU Common Lisp

◆ Robert A. MacLachlan

January 1992 **ACM SIGPLAN Lisp Pointers**, Proceedings of the 1992 ACM conference on LISP and functional programming LFP '92, Volume V Issue 1

Publisher: ACM Press

Full text available:  pdf(1.06 MB) Additional Information: [full citation](#), [abstract](#), [reference citings](#), [index terms](#)


The Python compiler for CMU Common Lisp has been under development for over five years, and now forms the core of a production quality public domain Lisp implementation. Python synthesizes the good ideas from Lisp compilers and source transformation systems with mainstream optimization and retargetability techniques. Novel features include static type checking and source-level debugging of compiled code. Unusual attention has been paid to the compiler's user interface.

18 Local type inference

◆ Benjamin C. Pierce, David N. Turner

January 2000 **ACM Transactions on Programming Languages and Systems (TOPLAS)**, Volume 22 Issue 1

Publisher: ACM Press

Full text available:  pdf(359.69 KB) Additional Information: [full citation](#), [abstract](#), [reference citings](#), [index terms](#), [review](#)

We study two partial type inference methods for a language combining subtyping and impredicative polymorphism. Both methods are local in the sense that missing annotations are recovered using only information from adjacent nodes in the syntax tree, without long distance constraints such as unification variables. One method infers type arguments in polymorphic applications using a local constraint solver. The other infers annotations for bound variables in function abstractions ...


Keywords: polymorphism, subtyping, type inference

19 Compiling functional languages with flow analysis


 Suresh Jagannathan, Andrew Wright

June 1996 **ACM Computing Surveys (CSUR)**, Volume 28 Issue 2

Publisher: ACM Press


Full text available:  pdf(162.07 KB) Additional Information: [full citation](#), [references](#), [index](#)

20 Compiling nested data-parallel programs for shared-memory multiprocessors

 Siddhartha Chatterjee

July 1993 **ACM Transactions on Programming Languages and Systems (TOPLAS)**
Volume 15 Issue 3

Publisher: ACM Press

Full text available:  pdf(4.17 MB) Additional Information: [full citation](#), [references](#), [citing index terms](#), [review](#)





Keywords: compilers, data parallelism, shared-memory multiprocessors

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- IEEE CNF** IEEE Conference Proceeding
- IET CNF** IET Conference Proceeding
- IEEE STD** IEEE Standard

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